

Chapter 16: Water & Wastewater Systems

Presenter:

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Water and Wastewater – Critical for Community Restoration

- Hospitals
 - Cooling
 - Laundry
- Personal
 - Drinking
 - Waste disposal
 - Washing
- Communication/
Computers – cooling
- Fire suppression
- Restaurants
 - Food preparation
 - Washing dishes
- Hotels – laundry
- Industry
 - Manufacturing processes
 - Cooling



Water and Wastewater – Dependence on Other Systems

- Power – pumping, treatment plant operation
- Transportation – roads to allow emergency response, recovery
- Communication – SCADA, emergency response
- Chemical supply – chlorine



Water and Wastewater Systems

Example Hazards/Vulnerabilities

- Supply
 - Flood/Inundation
 - Landslides/Turbidity
 - Contamination
 - Wildfire
- Transmission
 - Earthquake
 - Landslide



Water and Wastewater Systems

Example Vulnerabilities - continued

- Treatment
 - Flood/Inundation
 - Earthquake
- Pumping
 - Loss of power
- Storage
 - Wind
 - Earthquake
 - Contamination
- Distribution
 - Earthquake



Water and Wastewater – Historic System Outage Times

- Great Flood of 1993, Des Moines, Iowa
 - 12 days without water
 - 19 days without potable water
- Northridge (1994), Kobe (1995) Earthquakes
 - 1,000/1,200 pipeline failures
 - 12 days/60 days to restore service
- Hurricane Katrina restoration
 - 1-3 months – East Bank
 - 9 months Lower 9th Ward
- Christchurch (2011) and Tohoku Earthquakes
 - 40+ days for restoration



Water and Wastewater – Performance Goals

- Performance goals for routine (100 year return), design (500-year), and extreme (2,500 year) events
- Gaps between performance of existing system and performance goals
- Consistent across social needs and supporting infrastructure requirements
- Intermediate and long-term goals
- Driven by community stakeholders
 - Residential, commercial, industrial customers
 - Hospitals
 - Fire departments
 - System operators/ engineers
 - Interdependent system operators



Water and Wastewater - Performance Goals continued

Functional Category: Cluster	Overall Recovery Time for Hazard – Routine, Design or Extreme								
	Phase 1 – Short-Term			Phase 2 -- Intermediate			Phase 3 – Long-Term		
	Days			Wks			Mos		
	0	1	1-3	1-4	4-8	8-12	4	4-24	24+
Source									
Raw or source water and terminal reservoirs									
Raw water conveyance (pump stations and piping to WTP)									
Water Production									
Well and/or Treatment operations functional									
Transmission (including Booster Stations)									
Backbone transmission facilities (pipelines, pump stations, and tanks)									
Water for fire suppression at key supply points									
Control Systems									
SCADA or other control systems									
Distribution									
Critical Facilities									
Wholesale Users (other communities, rural water districts)									
Hospitals, EOC, Police Station, Fire Stations									
Emergency Housing									
Emergency Shelters									
Housing/Neighborhoods									
Potable water available at community distribution centers									
Water for fire suppression at fire hydrants									
Community Recovery Infrastructure									
All other clusters									

- Recovery goals set for system functions
 - Source
 - Transmission
 - Distribution
- Societal needs
 - Hospitals
 - Emergency shelters
 - Housing/neighborhoods
- Recovery time frame depending on needs
 - Short (days),
 - Intermediate (weeks),
 - Long term (months)



Water and Wastewater – Recovery

- Recovery is driven by:
 - Extent of damage
 - System redundancy
 - Hospitals
 - Emergency shelters
 - Housing/neighborhoods



Water and Wastewater – Regulatory Environment

- Federal/State –
 - SDWA, Clean Water Act - do not address system performance in catastrophic events
 - State – some planning, emergency planning requirements
- Codes and Standards, Manuals of Practice
 - ASCE-7, IBC, AWWA – address new construction of system components
 - Limited documentation on system performance in severe events



Water and Wastewater – System Assessment Approaches

- HAZUS-MH – multi-hazard assessment
 - Tool to evaluate system component vulnerabilities
- AWWA J-100 *Risk and Reliance Management of Water and Wastewater Systems*
 - Component risk – vulnerability and consequence
- System Assessment
 - Workshop approach – considering expected component damage, estimate restoration time
 - Computer models



Water and Wastewater – Improving System Performance

- First, develop a strategy, e.g. -
 - Retrofit key facilities - WTP or transmission mains
 - Replace most vulnerable pipe over time
 - Develop full redundancy with new facilities
- New construction – design to meet or exceed codes
- Existing construction
 - Evaluate and consider alternative potential solutions
- Cost of implementation
 - Establish performance requirements for all projects
 - Integrate upgrades with other projects
 - Establish an achievable time frame

